

SOLID WASTE RECYCLING

A PROPOSAL FOR TEXAS A&M UNIVERSITY

An Independent Study

Thesis
by
774893

John M. Potter

Submitted in partial fulfillment of the requirements
for the degree of

MASTER OF ENGINEERING

Committee Members:
Dr. Donn E. Hancher (Chair)
Dr. David Y. Chang
Dr. Winston T. Shearon

CVEN 685 July 30, 1990

T247969

SOLID WASTE RECYCLING

A PROPOSAL FOR TEXAS A&M UNIVERSITY

An Independent Study

by

John M. Potter

Submitted in partial fulfillment of the requirements
for the degree of

MASTER OF ENGINEERING

Committee Members:

Dr. Donn E. Hancher (Chair)

Dr. David Y. Chang

Dr. Winston T. Shearon

CVEN 685 July 30, 1990

774/893
C.1
TABLE OF CONTENTS

Report Objective	1
Introduction	2
Local Municipal Programs	3
Problem Quantification	5
Current Campus Recycling Activities	8
Problems with University Recycling	10
Current Recycling Markets	12
Outlook for Recycling Markets	17
Programs at Other Universities	18
University of Colorado (Boulder)	18
North Carolina State University (Raleigh)	20
Rutgers University (New Brunswick, NJ)	22
San Francisco State University (San Francisco)	24
University of Minnesota (Minneapolis)	26
A Proposed System for Texas A&M	31
Phase I - Pilot Program	32
Phase II - Expansion	36
Phase III - Campus Wide	37
Economic Feasibility Analysis	38
Phase I - Pilot Program	40
Phase II - Expansion	44
Phase III - Campus Wide	48
Recommendations and Conclusions	52
Attachments	54

Report Objective

The objective of this report is to investigate the feasibility of establishing a recycling program for any or all of Texas A&M University's solid waste. The scope of this investigation is restrained to that waste generated on the main campus in College Station only.

It is not the objective of this report to describe all possible methods of recycling. Rather, the focus is upon what Texas A&M University can do right now to enter into solid waste recycling, with minimal investment.

Certainly several higher technology methods than those presented within this writing exist, but the low tipping (landfill disposal) costs do not yet justify such measures and probably will not, in this area, until well into the twenty-first century. At that time, and indeed as long as any system is in use, the situation should be periodically evaluated and/or updated as warranted.

Additionally, the research has been discussed with the Recycling Subcommittee formed by the University Senate Planning Committee to study the feasibility of recycling by Texas A&M.

Introduction

Solid waste disposal is currently becoming a monumental problem nationwide. We simply cannot, because of environmental and resulting legal and financial problems, continue generating so much waste, only to bury it in landfills. We are running out of room and costs are steadily increasing. We must reduce the amount that is disposed of in these landfills.

In addition to the physical and economical aspects of landfilling trash, there are also the moral and ecological concerns. Simply continuing to bury recyclable materials as trash is nothing more than passing a problem along to future generations. We must do what we can to minimize the use of landfills right now.

One solution is to simply reduce the volume to be disposed of by recycling a portion of it. This is the thrust of this report, as applied to Texas A&M University.

Local Municipal Programs

Texas A&M used to own and operate its own landfill but currently uses the local municipal landfill for solid waste disposal, as do both the towns of College Station and Bryan. The operation was recently consolidated by the two cities into the current joint municipal effort on Rock Prairie Road, approximately two miles east of Texas Highway 6.

The two cities are preparing to launch a trial recycling pilot program which will involve 2,500 homes in Bryan and College Station¹. The city will pay a local contractor \$1.50 per house per month to collect the homeowner-separated recyclables (paper, aluminum and glass) which are to be placed at the curb in clear plastic bags provided by the contractor. The contractor will then store, compact or bundle, and finally sell the recyclables and pass the proceeds back to the city. The city will continue to collect the remainder of the refuse with their own employees.

The city does not expect to recover the collection cost but will absorb it for this year with a collection rate increase to be passed on to the citizens in the future when this (or a similar) program is expanded to the whole community. However, they expect an initial reduction of about 40% of the waste volume collected, later dropping to about 10%.

The only recycling now in place is that of corrugated cardboard boxes at large retail centers (Wal Mart, Post Oak Mall, Kroger, etc.) which use balers to crush and package the material.

Future plans include collection of recyclable plastics and the use of mechanized

¹ Conversation with Mr. Jim Smith, Solid Waste Superintendent, City of College Station, May 22, 1990.

equipment to pick up and dump standardized containers.

More immediate plans include retaining the services of an environmental engineering firm next fiscal year to evaluate the cities' options and to make recommendations as to long range solutions. At that time, all options will be considered, to include: incineration, composting, a central recycling separation facility, waste to energy conversion, etc. If such a plan does come to fruition, Texas A&M University should be fully involved as the single largest customer.

Problem Quantification

Texas A&M currently produces about 7,600 tons of solid waste annually and spends a total of \$470,000, or \$61.84 per ton to dispose of it. The waste is all collected and transported by Texas A&M employees with university-owned machinery. These figures do not include food and yard wastes (grass clippings, leaves, twigs, etc.) which are composted by the Grounds Maintenance Division nor construction wastes which are removed by the contractors².

Tipping fees (landfill disposal costs) were on the order of \$18 per ton at the College Station landfill prior to consolidation with Bryan. They are estimated to have dropped to about \$15 per ton now. Cost to haul the trash is estimated at \$8 per ton with trucks carrying about six tons per load.

The waste stream consists of mostly paper - this portion is estimated at 75%. The remainder is small portions (perhaps 5% each) of aluminum cans, plastics, glass bottles, wood and metals. Figure 1 is a graphic illustration of this breakdown.

In addition to the compactor trucks used by the Solid Waste Division, Texas A&M also uses large compactors located in several of the dormitory complexes. These compactors hold as much as nine regular bins. The dormitories are cleaned by a staff separate from those that clean the classroom buildings (Physical Plant staff) and the common buildings (Student Services staff).

The large outside containers that are not connected to compactors are dumped with

² Conversation with Mr. William P. Workman, Manager of Transportation Services (includes Solid Waste Division), Texas A&M University, May 22, 1990.

TEXAS A&M UNIVERSITY SOLID WASTE STREAM MAKEUP

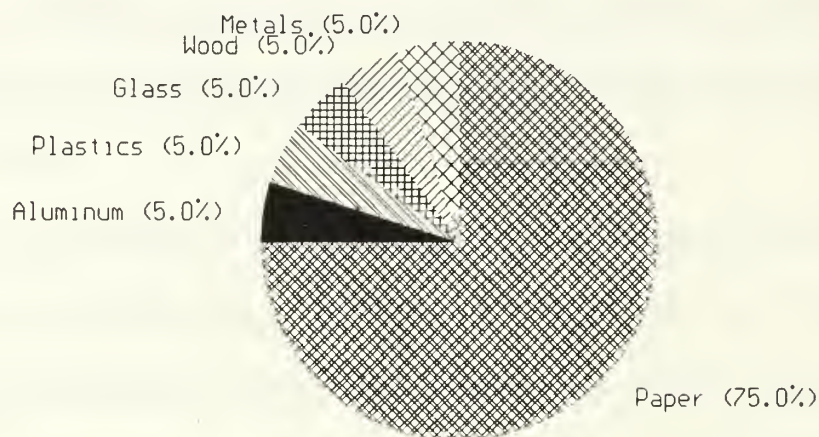


FIGURE 1

varying frequencies (daily to weekly) according to use, while those with compactors are usually dumped only once every ten days.

The university newspaper, The Battalion, is published nearly every weekday, the exceptions being holidays and semester breaks when it is published only on Wednesdays. Currently, the operation consumes 210 to 225 tons of newsprint each year³.

The Battalion staff would like to use recycled paper but cannot yet get it. About 10% of this production is distributed off campus to local businesses and apartment

³ Conversation with Mr. Hines, Battalion Staff, Texas A&M University, May 28, 1990.

complexes.

From the above, one can conclude that Texas A&M University generates approximately the following amounts of recyclable materials annually:

<u>Material</u>	<u>Tons/Year</u>
Newsprint	200
Other Papers	5,500
Aluminum	300

If this material could be removed from the waste stream by recycling, the total annual cost avoidance, counting just the tipping fees, at \$15.00 per ton would be \$90,000. Of course, the other revenues and expenses associated with the recycling program would have to be included in the bottom line figure as well, but this number shows that the potential for savings is significant.

Current Campus Recycling Activities

The few recycling activities currently happening at Texas A&M University are scattered and unrelated, for the most part. It appears that the desire to recycle does exist however, because the efforts are on the part and initiative of individuals and separate building staffs.

Until just recently, Texas A&M had a cardboard baler on loan from an Austin firm which was being used to bale the boxes discarded by Purchasing/Stores and the Commissary. The loaning firm then bought the baled material from the university, at a reduced price. This pilot program started in March 1990 but was only temporary⁴. In the period of March 19, 1990 to May 15, 1990, the university processed and sold 43,310 pounds of cardboard at \$15 per ton as well as 20,550 pounds of old class catalogs.

Unlike some of the other universities contacted, Texas A&M University Grounds Maintenance has been collecting and composting their yard wastes (grass clippings, leaves, twigs, etc.), rather than disposing of them in the landfill, for several years now. This is a significant "headstart" in getting a full fledged recycling program underway.

In addition, the university accumulates a large quantity of wooden transportation pallets. These pallets are left over when the transported goods are unloaded and the vendors do not want them back. The pallets are stacked up currently until a representative from the Texas Department of Corrections unit at Huntsville comes to collect them. The Prison Industries System repairs them as needed and uses them to package the inmate-

⁴ Conversation with Mr. Joe Estill, Assistant Director, Physical Plant, Texas A&M University, May 9, 1990.

produced products for shipment.

The Purchasing/Stores Division collects, separates and later auctions off scrap and waste metals generated by the university.

Twin City Mission in Bryan collects a small amount of paper and corrugated cardboard from a few buildings on campus in an arrangement with the person in charge of the areas. No formal agreement exists but no money changes hands either.

Sunbright Paper in Waco also collects a small amount of paper, both high grade and newsprint, from a few buildings on campus. The efforts in the buildings are on the part of the occupants and include the Evans Library, the Oceanography / Meteorology building, the Soils / Crop Sciences building, and some of the College of Medicine's buildings. Sunbright provides the large (main) containers for the buildings.

Finally, Bruegging Paper Stock, a local recycling firm, provides 55-gallon drums to offices around the campus that request them for collection of bond paper⁵. Bruegging then collects the drums when full and pays the university two cents per pound of laser printed or photocopied paper and four cents for that printed or typed upon.

⁵ Conversation with Mr. Joe Bruegging, owner, Bruegging Paper Stock, April 14, 1990

Problems with University Recycling

One of the main problems to be overcome is separation of the recyclables from the rest of the waste. This separation can be accomplished by two different procedures: source separation or site separation.

In the first method, separate receptacles are provided for the users to discard of the recyclables separately from the non-recyclables. This might include several containers - one for paper, glass, aluminum, etc. The problem here is the need of several times as many containers and extra staff and/or equipment to handle them.

In the latter method, the refuse is all collected in a common container and separated at the disposal/recycling site. Of course, added costs are involved in sorting the mixture when it arrives. Mechanized equipment is commercially available to handle the bulk of this separation.

The prevalent feeling among the Physical Plant administrators contacted is that the current staffing would not allow for handling the multiple containers that would result from source separation.

Another major stumbling block to recycling is the uncertain market. With the sole exception of aluminum and other non-ferrous metals, the market prices of recyclables are prone to large swings in price. One just cannot say with any great confidence what the economic feasibility of a program will be with this kind of uncertainty. The danger of ending up having to store or otherwise dispose of a mountain of used newsprint, for example, is very real. However, no matter how low the market price may drop (as long as the merchants will still accept the materials), landfill costs are still avoided as well as the

future ecological problems.

Current Recycling Markets

As mentioned above, one of the major potential drawbacks to effective and economical recycling is the uncertainty of the markets. Right now, the market for used newsprint is glutted and it cannot be sold locally, only donated. The market for glass and plastics is also poor - two cents per pound. The aluminum market remains stable with moderate growth.

However, other markets in the surrounding area are a different story. Two nearby buyers were contacted, in Austin and in Waco for their current prices. Details are given below.

Currently, there are four local (in the Bryan - College Station area) dealers who will buy aluminum cans. The going rate is \$0.35 per pound and the cans need not be crushed. Some dealers even have the capacity to automatically cull the steel or bimetallic cans from a mixture prior to the weighing process. The four dealers are:

- * Brazos Beverages Inc., 505 North FM 2818
- * Bruegging Paper Stock, 1919 FM 2818
- * Bryan Iron and Metal, 201 Texas 21 West
- * Valley Recyclers, 1504 Finfeather Road

The aluminum market is very strong and there are several buyers to choose from.

As for paper, the local market is much poorer. There is only one local buyer:

Bruegging Paper Stock (see above). Currently Bruegging's prices are as follows⁶:

<u>Type of Paper</u>	<u>Pound Price</u>
Computer Printout (Non-Laser)	\$0.045
Mixed (Laser, Colored, etc.)	\$0.01
Coated (Smooth)	\$0.01
Newsprint, Stapled Magazines	\$0.00
Corrugated Cardboard	\$0.005

Note that Bruegging will accept newsprint and magazines with stapled bindings (not glued) but will not pay anything for them. Mr. Bruegging expressed an interest in entering into an arrangement with Texas A&M to buy recyclable materials and said that he would be very willing to increase his capacity to take whatever volume (say, 1,000 tons/year, to begin) agreed to.

There is another outlet for recycled materials in Bryan, the Twin City Mission, at 500 North Main Street. The Mission's Recycle Program Administrator is Mr. Doug Weedon whose phone number is 822-7511.

Mr. Weedon is very interested in establishing an agreement with Texas A&M University to collect any recyclable materials⁷. In fact, he has been trying for months, with

⁶ Conversation with Mr. Joe Bruegging, owner, Bruegging Paper Stock, July 16, 1990

⁷ Conversation with Mr. Doug Weedon, Recycle Program Administrator, Twin City Mission, July 16, 1990

no success, to do so. Thus far, he collects cardboard from only about six buildings. Mr. Weedon indicated that the large increase in volume (say, 1,000 tons/year, to begin) would not be a problem for his program.

Twin City Mission is a charitable organization, providing aid to the local needy and homeless populations. A large part of their operating revenue comes from their recycling program.

Twin City provides scheduled and on-call pickups of all commonly recycled items (and some that aren't) including paper, cardboard, aluminum, glass, rags/old clothing, and almost anything else that they can sell outright or refurbish and later sell. They operate their own trucks and have baling equipment for paper and cardboard.

Of course, being a charitable organization, Twin City Mission does not pay for the materials they collect. Nearly all of their labor is supplied by volunteers, the needy people they serve, and by local citizens assigned to public service as restitution for misdemeanor crimes.

Though Twin City Mission cannot pay for the material they collect, they could save the donator money through landfill cost avoidance as well as collecting and hauling costs. All they ask is that the material be of sufficient quantity to be economical for them to pick up and that it be gathered in central locations. Neither of these requests would be a problem at Texas A&M University.

One of the out-of-town buyers contacted is Sunbright Paper in Waco. A Mr. Leonard Englander is their manager and may be reached at (817)776-1977. Sunbright's current prices, delivered to their plant in Waco are as follows:

<u>Type of Paper</u>	<u>Pound Price</u>
Computer Printout (Non-Laser)	\$0.04
Mixed (Laser, Colored, etc.)	\$0.0025
Newsprint	\$0.008
Corrugated Cardboard	\$0.0125

Their price on aluminum cans is essentially the same as the local dealers at \$0.36 per pound. Mr. Englander is very interested in continuing his business with Texas A&M University and would very much like to see it expanded to a campus wide contract⁸.

The other out-of-town buyer contacted is Acco Paper in Austin. Acco also has plants in San Antonio and Houston, to name their other nearby locations. Acco's (Austin) Manager is Mr. Tommy Stubblefield, at (512)223-2618. Acco's current prices, delivered to their plant in Austin are as follows⁹:

<u>Type of Paper</u>	<u>Pound Price</u>
Computer Printout (Non-Laser)	\$0.07
Mixed (Laser, Colored, etc.)	\$0.0005
Newsprint	\$0.001
Corrugated Cardboard	\$0.01

⁸ Conversation with Mr. Englander, July 18, 1990

⁹ Conversation with Acco buyer, July 18, 1990

Their price on aluminum cans is essentially the same as the local dealers at \$0.37 per pound.

Outlook for Recycling Markets

A good source of information on the current market prices is Waste Age's Recycling Times, a biweekly publication of the National Solid Wastes Management Association. Each issue contains a section called "The Markets Page" which lists current prices for various recyclables from paper, to plastics, to metals, to used auto batteries. Unfortunately, Evans Library does not subscribe, nor does any other Texas educational institution or public library, according to their OCLC nationwide electronic catalog of university and public library holdings.

From conversations with Bruegging Paper Stock, Twin City Mission, Acco Paper and Sunbright paper, a consensus of opinion outlook for the future of the paper and aluminum markets was generated. The paper markets appear (within Texas) to be stabilized for the time being, at the low current prices.

As may be seen from the quotes above, the big money is in the higher grades of paper - non-laser printed computer printout (large size, white, green, or blue bar form, no carbon) and aluminum cans. The market for these two continues to rise and is the most reliable. The markets for mixed paper, newsprint and corrugated cardboard on the other hand are very low, but also appear to be stabilized, having changed very little over the last year.

Programs at Other Universities

Recycling is becoming commonplace at several larger universities in the United States. As part of the research process for this report, several program directors were contacted and detailed information was received on their systems. A summary of each of the programs investigated and some major points about each are given below.

University of Colorado (Boulder)

The University of Colorado, a school of 24,000, has had a formal university-operated program in place since 1980. Their program director is Mr. Jack DeBell whose phone number is (303)492-8307. The University of Colorado receives funding for the program from student fees, Boulder County, and avoided disposal costs¹⁰.

They currently recycle paper (office, news, cardboard, text and phone books), plastics, metals (aluminum and ferrous), glass, organics, and auto batteries and oils at a rate of about 700 tons per year, or about 25% of their waste stream. Total costs of the program were about \$48,000 for fiscal year 1988 and about \$51,000 for fiscal year 1989, while total revenues/cost avoidances were about \$55,000 and \$56,000, respectively. Thus, the University of Colorado is making a small margin of profit.

As with most programs, the revenues are inconsistent due to wide fluctuations in the markets. They do, however, receive some free labor from the County Court system through people sentenced to public service for misdemeanor offenses.

¹⁰ Information in this section taken from conversation with Mr. DeBell and "The University of Colorado Recycling Program - A Summary Report", J. DeBell, Director, C.U. Recycling, Boulder, CO, 1990

CU Recycling currently uses six types of receptacles: desk top and below desk cardboard boxes, 40-gallon cardboard drums and 55-gallon steel drums, two cubic yard capacity wheeled metal bins, and large "palletainers" (bins constructed upon pallets and moveable with forklifts). The type of container used in a particular location depends upon several factors including: required capacity, accessibility and ease of transportation from indoors to outside, initial cost and projected payback, aesthetics, and uniformity in color and shape. The ultimate goal is to minimize the handling required.

The University of Colorado currently has a campus wide program - every building is included in the service. The system includes 166 official "Recycling Stations". Each Recycling Station has one to four containers for source separation as well as one for non-recyclables (trash/garbage) to discourage contamination. They rely very heavily upon source separation, coining the phrase "A little of your time saves a lot of ours".

Their system is centralized to a certain extent in that some of the users transfer the recyclables from their individual buildings or desks to central collection bins, thereby relieving some of the burden on the recycling staff.

Support from the custodial staff is strong as they are allowed to take aluminum cans from certain collection bins and sell them to raise money for their department party. While this practice detracts from the revenues generated, it pays off in avoided landfill costs and increased willingness to participate on the custodians' parts.

Once deposited in the central collection containers or hauled out of the buildings in hand carts, the recyclable materials are picked up by trucks operated by conspicuously uniformed program employees, helping promote awareness.

Once collected by the trucks, the materials are hauled to a central storage facility where any necessary additional sorting is done and they are accumulated in large roll off containers (for newsprint) and covered van trailers for the remainder. When full, the trailers are pulled to the buyer.

The University of Colorado is very committed to spreading the word throughout the campus. Regular promotions include: press releases, petitions, public presentations, information booths, displays, standard logo and color scheme (chosen through a contest), doorhangers, and submission of recycling articles (from other sources) to the school paper.

A particularly interesting aspect of the University of Colorado's program is the specific targeting of foreign student education, the thought being that recycling might not be a concept familiar to them. Accordingly, signs are provided in the married student housing areas and in certain office areas in various languages such as Chinese, Korean, Spanish and Vietnamese.

Recycling is one of the subjects presented to incoming freshmen at the University of Colorado during orientation and is continually pushed by the residence hall assistants. The fraternities and sororities are being targeted for more help currently.

North Carolina State University (Raleigh)

North Carolina State University, a school of 26,000, has had a formal university-operated program in place since 1987. Their program director is Mr. Randy Bowen whose

phone number is (919)737-2181, extension 240 ¹¹.

North Carolina State University's program is operating under a state mandate of a 25% solid waste volume reduction and receives funding for the program from the university. Mr. Bowen says that he is currently having budget trouble as he is being forced to store some of the recyclable materials (mainly paper) because the local market is glutted. Storage for market timing is one of his biggest problems. Since he cannot make the profits he needs from sales and storage space is scarce, his situation is difficult at present. In spite of all this though, interest in recycling remains high across the campus.

North Carolina State University currently recycles paper (office and news), metals (aluminum and ferrous), glass, organics, textiles, and construction debris at a rate of about 1,400 tons per year. High grade office paper and green bar computer paper are the major moneymakers for North Carolina State University, but storage and separation problems continue to hamper them.

Some of their separation is done at the source where separate containers are provided (as appropriate) for newsprint, computer paper, other high quality paper, mixed paper, aluminum cans, and steel beverage cans. The can containers are fitted with lids with can-sized holes that prevent depositing larger (non-can) items and are lined with plastic bags to speed collection.

Some separation is also done by the custodial staff, both in collection and disposal of wastes. The recycling staff goes around to all the sites on scheduled regular routes and

¹¹ Information in this section taken from conversation with Mr. Bowen and his assistant, Mr. W. C. Horton

collects the recyclables and also pulls cardboard boxes and plastic bottles out of the waste stream for baling and eventual sale. The university owns and uses a mobile unit for their baling needs.

Scrap metals are also picked up by the recycling staff, on an as requested basis. The metals are later hand sorted by the staff and sold. North Carolina State University does not currently recycle any wood.

Glass bottles are collected across the campus in special drum containers. These containers have been modified by cutting holes in the bottoms to prevent trapping rainwater and are marked for color separation of the glass (clear, green and brown). The recycling staff also makes regular rounds of these containers and transports the glass to a central site for later sale.

North Carolina State University is currently selling about \$28,000 worth of recyclables each year and estimates their cost avoidance over landfilling to be about \$30,000 for a total of \$58,000. The program's annual budget is about \$74,000.

Rutgers University (New Brunswick, NJ)

Rutgers, a school of 32,000, has had a formal university-operated program in place since 1987. Their program director is Mr. Raymond Ching whose phone number is (201)932-5858. Mr. Ching claims that Rutgers' is the largest university recycling program in the country¹².

¹² Information in this section taken from conversation with Mr. Ching and "Rutgers Recycling Guide", Facilities Maintenance and Operations, 1989, and "Mandatory Recycling at a Major University", V. R. Coston and R. Ching, Rutgers, the State University of New

Like North Carolina State University, Rutgers operates under a state mandate and receives funding for the program from the university. They currently recycle paper (office, news, and cardboard), plastics, aluminum, glass, organics, and auto oils at a rate of about 2,600 tons per year, nearly a third of their waste stream.

Rutgers' program is operated by its director plus four permanent staff members and owns two vehicles. This staff and the vehicles cost them about \$90,000 per year. They figured an annual cost avoidance of \$129,000 in 1988 and \$146,000 in 1989 by not hauling the recyclable portion of their waste to landfills.

In addition, the total revenues from the recyclables sold amounted to \$26,600 in 1988 and \$4,500 in 1989. The large revenue drop in 1989 is attributable to softening of the paper markets and the buyers' subsequent refusal to pay for commingled (non-separated) paper which then had to be landfilled and discontinuing separation of aluminum cans and glass bottles (selling them commingled instead).

Rutgers has an excellent education/awareness program for the university population. This, of course, helps their source separation and overall program participation rates tremendously. A few examples are their Desk Collection Folders, their Recycling Guide for Custodians, and their color-coded dumpsters and other containers. Of course, since Rutgers is under a state mandate to recycle, they can force participation more than Texas A&M could but some of the same publicity methods should be effective here as well.

The Desk Collection Folders are simple legal-sized folders with instructions printed on them for use of their recycling system. The instructions detail which materials are and

are not recyclable and tells the reader what he must do with them for processing.

Such a folder was placed on every office desk for the occupant to dispose of recyclable paper inside it, rather than in the trash cans. Thus separated, it is a simple matter for the custodial workers to just empty the folders each time they clean. A copy of front and back covers of these folders is included in this report as Attachment A.

The Recycling Guide for Custodians is in poster form, printed in both Spanish and English, and displayed in every janitorial closet. A copy of the English version of this poster is included at the back of this report as Attachment B.

Finally, Rutgers currently uses a three-container system. The containers are either painted with the appropriate color or stickers are affixed to them to identify their intended contents. In keeping with patriotic spirit, the colors are red, white and blue.

The red containers are for commingled aluminum cans and glass and include hallway cans as well as outside dumpsters which the contractor empties. The white containers are essentially the same thing, but are for commingled paper (office and newsprint). The blue containers are for "all others" - trash/garbage that is transported to the landfill. In addition, plastic can liners are not allowed to be left in the red and white containers; they must be emptied into them and disposed of in the blues.

San Francisco State University (San Francisco)

San Francisco State University, a school of 28,000, has had a formal university-operated program in place since 1989. The program began as a student initiative and continues to rely on student cooperation and involvement. Their part-time university

program director is Mr. Robert Hudson whose phone number is (415)338-1568; the student-run recycling center phone number is (415)338-1947 ¹³.

San Francisco State University receives funding for the program from the university and the student association. They currently recycle paper (office, phone books, and news), aluminum, and glass at a rate of about 114 tons per year.

While San Francisco State University has yet to show a profit, they expect their fixed tipping fee per load to steadily increase such that they will show cost avoidance in excess of the program costs in the mid 1990's. Total sales in 1989 amounted to about \$10,000.

San Francisco State University's program involves the standard system of containers distributed around the campus. Separate containers are provided alongside desks in the offices to separate high grade paper from other wastes, and special containers are provided across the campus to collect newspaper, aluminum and glass.

The office paper containers are emptied by student workers (including some from a neighboring handicapped educational institution) into carts which are then dumped into collection barrels. Some containers are on regular routes while others are emptied on an as requested basis.

The full collection barrels are picked up by a recycler who then pays San Francisco State University. A similar system is used for glass and newsprint.

Aluminum cans are collected through special containers in the Student Center, mainly, as San Francisco State University does not have vending machines in the classroom

¹³ Information in this section taken from "San Francisco State University Recycling Center Annual Report 1988-1989" and "Proposal for Campus-Wide Recycling Program" S. Reider, et al, San Francisco, CA, June 1986

buildings. They are looking into the possibility of doing all of the collections with custodial staff and separate containers right now.

Mr. Hudson estimates that San Francisco State University's waste stream is 45% paper right now and that their cost avoidance is on the order of \$20,000 per year. However, they are also currently suffering due to the poor paper market.

Collection of San Francisco State University's recyclables is accomplished through the use of regularly scheduled pickup routes as well as an "on-call" service. Three different containers are used: 30-gallon, 60-gallon, and 90-gallon wheeled plastic containers. The containers have appropriately modified lids to discourage contamination through introduction of non-recyclable or wrong type materials. Containers are clearly marked with the program logo and are color coded. Additionally, small desk top containers are used.

Several buildings were specifically targeted from the onset as big producers of recyclables: computer labs, copy centers, large offices, the student union, and dormitories. Once deposited by users into building collection containers, the recyclables are gathered and placed on loading docks outside for collection by the program staff using pickup trucks.

Education is also a big part of San Francisco State University's efforts. Ads are continually placed in the campus newspaper, the Golden Gater, to increase student and staff awareness and participation in the program.

University of Minnesota (Minneapolis)

The University of Minnesota, a school of 41,000, has had a voluntary formal university-operated program in place since 1983. Their program director is Mr. Dana

Donatucci whose phone number is (612)624-8507 ¹⁴.

The University of Minnesota receives 70% of the funding for their program from the Hennepin County Board of Commissioners and the balance from the university. They currently recycle paper (office, news and cardboard), aluminum, glass, and organics at a rate of about 1,800 tons per year, or about 21% of their waste stream.

Unlike here at Texas A&M University where it is about 23%, the tipping fee for the University of Minnesota's waste disposal is now in excess of 60% of the annual solid waste operation cost! One can see how this encourages them to recycle or to reduce their waste volume in general. Indeed, the University Board of Regents passed a mandatory, university-wide Waste Abatement Policy in 1985.

A unique aspect of the University of Minnesota's program is in their collection of corrugated cardboard. The process begins with the custodians stacking the boxes in the trash areas separate from the other trash, making sure they are empty of packing materials (styrofoam, etc.). There is no need to flatten the boxes as the recycling staff comes around later with a compactor trash truck, crushes the boxes, and hauls them directly to the buyer.

This process greatly reduces necessary labor and avoids the double handling necessary to use a central baler for numerous outlying sources. Of course, it is still economical to use a stationary baler at high output locations, again, to avoid double handling. At the end of 1989, the University of Minnesota was collecting nearly two tons

¹⁴ Information in this section taken from conversation with Mr. Donatucci and "The University of Minnesota Recycling Program Implementation and Operation Manual", University of Minnesota Recycling Program, Department of Physical Plant Operations, Minneapolis, MN, 1990

of cardboard each day.

Like most major universities, the University of Minnesota publishes a school newspaper which consumes a lot of newsprint which later becomes part of the waste stream. Through constant and intensive media attention, they have developed a successful newsprint collection program as well. In 1989 they collected 227 tons of used newsprint.

High quality office paper makes up the bulk of the University of Minnesota's program with 95% source separation. They use a three-part system with special containers separated by a recyclable paper slot, a small cans/glass hole and a larger trash opening. The containers were manufactured by the university and they are currently looking for an affordable commercial substitute.

An interesting incentive the Department of Physical Plant Operations provides is in the form of credit for separated recyclable refuse from the university "Self-Support Units". These are the organizations on campus that are semi-autonomous, non-academic departments or buildings that have their own administrations, budgets and employees. Examples include: residence halls, food services, and student centers. Although separate from the University in many ways, most of these units have the Physical Plant collect their trash, on a reimbursable basis. The credit provided is for the avoided tipping fees.

Another interesting aspect in the University of Minnesota's program is their well-organized, methodical approach to bringing new buildings and their occupants into the program. The process begins with a survey of the building to determine what materials should be collected as well as an estimate of quantities, and the number and location of collection containers required.

The next step is to obtain fire safety approval for the storage location, then establish a building contact. Having a person in the building to contact is a definite asset as they can help avoid duplication of special requests (such as for unscheduled pick ups) and can help improve the program by suggestions to better tailor the service to the building. A further benefit to the contact idea is the team building aspect. By keeping the occupants involved in the process, a sense of purpose and pride is developed, helping keep participation at its highest.

These steps completed, the collection day(s) and frequency are set and the custodial staff is notified of the effective date. Once the players and equipment are in place, the Program administration schedules an Orientation Presentation for the building users and puts on a short program detailing their responsibilities and answering any questions. After startup, periodic visits are conducted and followed up with three, six and twelve month progress reports.

The building occupants do play an important part in the whole scheme. Specifically, most are required to attend the Orientation where they are provided recycling trays (boxes) which allow them to conveniently separate acceptable paper for the office paper program and newspaper for the newspaper program. When the recycling tray is full, the employees are responsible for emptying the contents into a conveniently located, clearly marked recycling barrel. This completes the occupants' role in the process.

From the recycling barrels, the custodial staff takes over. When a barrel is full, the custodian empties it into a larger container, either a canvas hamper or a palletainer for storage and later collection by truck.

One can readily see the team spirit and resulting attitude change when the program involvement is as widespread as at the University of Minnesota. Certainly there is some resistance at first, but the ultimate benefits merit the effort to gain cooperation.

A Proposed System for Texas A&M

Following is an outline of a suggested procedure for implementation of a recycling program for Texas A&M University main campus. The program would consist of three phases, each one building upon while retaining the former one(s). Using this approach, the financial impact is lessened dramatically and more flexibility exists.

Phase I - Pilot Program

Nearly all current campus recycling programs looked at began as student initiatives. That is, they were originally conceived of, implemented and operated solely by student groups. In fact, several still rely upon student involvement, beyond the attitude change and extra effort required to recycle waste. Student workers in work/study programs are still commonly employed.

Once the programs grew and began to show some success, the universities began to show official interest in the matters and to provide support, both fiscal as well as labor and equipment. Of course, escalating disposal costs and academic/environmental concerns contributed to the official interest as well.

It is important to involve the student population in order to change the mind set of the current (and future) generation that we can just continue to toss all waste in the trash can and haul it off and bury it in a landfill. Thus, the Texas A&M student body needs to be involved.

The Work/Study program here at Texas A&M University would be an excellent source of student labor to support the program. Positions are easy to gain, as long as the department concerned has the funds for their 20 or 30% share (depending on the program) of the wages. The remaining 70 or 80% comes from federal and/or state sources. The only restriction is that the student can work twenty hours per week, maximum, until the money is gone.

A position in the recycling program would be an excellent learning experience for students in several majors, ranging from civil/environmental engineering, to natural sciences,

to business administration.

The involvement of the custodial staffs is essential as well. Because of the transient nature of the student staff (semester breaks, graduation, etc.), a consistent element is critical for program continuity. That is, the program needs and deserves a permanent university employee to keep it running smoothly and thus maximize its benefits. In this initial pilot phase, a part time employee would probably be sufficient. It might even be possible to have a current employee take on this responsibility as an additional duty.

A good pilot program would involve a few collection containers in strategically located areas for a select few recyclable materials. Some of these areas already have recycling underway. Thus, a formal pilot program there would be much easier to start since the staff is already used to recycling. Refer to the "Current Campus Recycling Activities" section for some areas known to already be active. More specifically, initial formal program target locations might include:

<u>Location</u>	<u>Material(s) Collected</u>
Evans Library - Vending Area	Aluminum Cans
Evans Library - Entrance	Newsprint
Evans Library - CPD	Newsprint
MSC - Main Entrance	Aluminum, Newsprint
Blocker Building - Vending Area	Aluminum Cans
Blocker Building - Main Entrance	Newsprint
Zachry Building - First Floor	Aluminum, Newsprint

Teague Computing Center	Computer Paper
Academic Computing Center (BLOC)	Computer Paper
Remote Computing Center	Computer Paper
Zachry Output Center	Computer Paper
Purchasing/Stores	Corrugated Cardboard
Copy Centers:	Bond Paper
* Evans Library	
* Oceanography & Meteorology Building	
* Reed McDonald Building	
* Memorial Student Center	
* Engineering Research Center	
* Langford Architecture Center	

With the exception of a baler for the cardboard waste generated by Purchasing/Stores, this first phase would not involve any sophisticated equipment or any great capital expenditure. The collection containers could be as simple as barrels for the aluminum cans and wheeled bins for the paper and newsprint. It is important that the containers be out of the weather to minimize losses due to rotting and litter by wind-carried paper, etc.

Because the system relies upon source (user) separation, the barrels would require clear markings and lids with a can-sized hole cut in the top to discourage users depositing other materials. The bins for the computer paper and newsprint would also need to be

clearly marked. In either case, a container for other wastes should be provided right next to the one for recyclables to make it convenient. One of the key points in a voluntary system is convenience.

Once the program is started, collection frequencies could be determined based upon observation. Under full participation, it would probably be necessary to empty the newsprint containers every day the Battalion is published.

The aluminum containers should be lined with plastic liners which would be removed during collection for sanitary reasons (eventually these liners might be recycled as well).

It would probably be easiest to accomplish the collection with university custodial employees (perhaps combined with work/study students) or a contracted buyer/collector.

The collection vehicle would not have to be anything specialized, just a simple, covered cargo vehicle that is easy to load and unload. A utility (step) van would be ideal, with pallet-mounted bins inside to hold the separated materials.

A couple of wheeled handcarts with large (on the order of one cubic yard) dump bins mounted would also be handy for ease of transport of the materials from the building collection containers to the vehicle. With such a cart, the collector can simply wheel it up to the collection container, empty the container into the bin, replace the container and wheel the cart out to the truck. This process eliminates the need for return trips to replace the emptied containers if they are used to transfer the recyclables to the vehicle (simply "dump and go" instead).

Phase I could easily begin within one year of the decision to formally commit Texas A&M University to solid waste recycling.

Phase II - Expansion

In addition to continuing the efforts described in Phase I, this second phase would expand to include dormitories and the other larger classroom and office buildings. As well, collection would be expanded to include office paper.

Also like the first phase, source separation would continue to be an integral and essential part of the program. Rutgers has an excellent campus recycling education/awareness program which makes this part much easier. An intensive advertising program like theirs in The Battalion and faculty emphasis on the program could help Texas A&M University too.

It is estimated that Phase II could begin within two years of the inception of a successful Phase I program, with total recycling reaching 20% - 30% of the total solid waste generated.

Phase III - Campus Wide

The final phase would involve the entire university campus, similar to what Rutgers (discussed previously) has in place right now. Every desk would have two (or one special divided) waste containers - one for recyclables and another for non-recyclables (trash). Recycling would now be an automatic, everyday effort for everyone on campus.

It is estimated that Phase III could be implemented within five years of the inception of a successful Phase I program, with total recycling exceeding 30% - 50% of the total solid waste generated.

Economic Feasibility Analysis

Custodial services for the various areas of Texas A&M University main campus are provided by one of four different organizations. In an effort to estimate the number of trash containers currently in use across the campus, managers for the four different staffs were contacted and polled as to plastic trash can liner consumption. In addition, the main Purchasing/Stores department was contacted to get the total number of bags purchased by the university.

The rationale behind trying to estimate the number of trash cans in use across the campus is useful in estimating the number of recyclable collection containers that might ultimately be needed as well as the time to collect the recyclable materials.

Service to the twelve Corps dormitories is provided under the direction of Mr. Sam Reyes (845-3035). The consumption of plastic bag can liners averages about ten 33-gallon size bags per day per floor, for 48 floors, five days per week. Thus, about 124,800 bags are used per year in these areas.

Service to the rest of the dormitories is provided under the direction of Mr. Gene Zdziarski (845-2235). The average consumption of plastic bag can liners in these areas was not available so it will be back calculated from the total number for bags used per year in these areas.

Service to the Memorial Student Center / Rudder Complex is provided by the University Center staff under the direction of Mr. Joe Luther (845-8905). The semi-annual consumption of plastic bag can liners averages about 25,200 of the 33-gallon size bags (collected 7 days a week) and 26,500 of the office can size (collected 5 days a week). Thus,

about 103,400 bags are used per year in these areas.

Service to the rest of the buildings on the main campus (offices, classrooms, etc.) is provided by the Physical Plant Department, Custodial Services, under the direction of Mr. Robert Mathis (845-5441). The annual consumption of plastic bag can liners averages about 765,000 of the 33-gallon size bags and 2,040,000 of the office can size (both collected 5 days a week). Thus, about 2,805,000 bags are used per year in these areas. The work is done by 17 crews, totalling 350 employees, with an average salary of \$5.06 per hour. The total annual budget is currently \$4.4 million.

The total number of bags purchased by Texas A&M University through the first nine and one half months of fiscal year 90 projects out to an annual amount of 1,765,000 office can size bags, 1,166,000 33-gallon size bags and 126,000 45-gallon size bags.

However, upon adding up the estimates provided by the staffs, one finds discrepancies between the totals. Therefore, the total numbers supplied by the Purchasing/Stores department are used in the estimate.

The grand total of the liners figures supplied by Purchasing/Stores is 3,057,600 liners used per year. Assuming that (on average) each liner is used once and that each can is emptied five days a week for fifty weeks per year, this works out to approximately 12,230 cans across campus, or, about 77 per building, again on the average.

Phase I - Pilot Program

Following are three cases used in evaluation of the first phase. Prices used are the average, per ton, of those found in the local dealer survey (refer to the "Current Recycling Markets" section). Quantities are calculated based upon the percentages listed and the total tonnages given in the "Problem Quantification" section, with the following as an assumed breakdown of the "Other Papers" portion:

Total Weight, "Other Papers":	5,500 Tons/Year
Assume 25% Computer Printout:	1,375 Tons/Year
Assume 25% Corrugated Cardboard:	1,375 Tons/Year
Assume 50% Mixed paper:	2,750 Tons/Year

The percent of total is calculated based upon the annual total of 7,600 tons now being landfilled.

<u>Material</u>	<u>Price</u>	<u>Pessimistic</u>			<u>Median</u>			<u>Optimistic</u>		
		<u>%</u>	<u>Wt</u>	<u>\$K</u>	<u>%</u>	<u>Wt</u>	<u>\$K</u>	<u>%</u>	<u>Wt</u>	<u>\$K</u>
Aluminum	\$720	10	30	22	20	60	43	30	90	65
Com. Pap.	\$103	20	275	28	40	550	57	50	688	71
Cardbrd	\$18	20	275	5	30	413	7	40	550	10
Newspap	\$6	20	40	.2	40	80	.5	50	100	.6
Mxd. Pap.	\$12	10	275	3	10	275	3	10	275	3

<u>TOTALS</u>	<u>Tons</u>	<u>\$(000)</u>	<u>Tons</u>	<u>\$(000)</u>	<u>Tons</u>	<u>\$(000)</u>
	895	\$58	1378	\$111	1703	\$150

REVENUES

Thus, under the Pessimistic Case, a total of 895 tons (12% of the annual total generated) of waste would be diverted from the landfill and sold for an estimated \$58,000. Under the Median Case, a total of 1,378 tons (18% of the annual total generated) of waste would be diverted from the landfill and sold for an estimated \$111,000. Under the Optimistic Case, a total of 1,703 tons (22% of the annual total generated) of waste would be diverted from the landfill and sold for an estimated \$150,000.

Besides the recyclable materials sales, the landfill cost avoidance on them (at the current \$15 per ton) would amount to \$13,425 in the Pessimistic Case, \$20,670 in the Median Case, and \$25,545 in the Optimistic Case.

EXPENSES

For Phase I, it is assumed that the following people and equipment would be adequate. Note that no transportation (except from the buildings to storage) or marketing costs are included as any of the buyers contacted are willing to come pick the material up from a central location. It is possible that the out of town dealers (Acco and Sunbright) would either cut their prices a small percentage or want to be guaranteed a certain minimum quantity to make the trip, but any such adjustment should be minimal.

<u>Asset</u>	<u>Annual Cost</u>
Director (1/2 time)	\$15,000
Collectors/Sellers (2 students)	\$8,000
Truck (Step Van)	\$10,000
Containers (18 locations)	\$5,000
Custodial Time (18 loc @ 2 hr/day)	\$45,000
Storage Facilities (temporary)	\$5,000
Total Costs	<u>\$88,000</u>

SUMMARY

Thus, under the three cases estimated:

<u>Case</u>	<u>Net Income (Loss)</u>
Pessimistic	(\$16,160)
Median	\$43,718
Optimistic	\$86,950

Note that the chance of making a profit appears to be great. The figures used in the Pessimistic case are quite conservative (low), as are those used for the expenses (high).

Another item of note is the total percentage of the waste stream recycled under each case (12, 18, and 22%). It does not seem logical that a pilot program would produce numbers that are on the level of the other schools contacted, most of which have had

programs in place for some time. It is the writer's opinion that this must be attributed to their including yard wastes (grass clippings, leaves, twigs, etc. which are undoubtedly a large portion of their total solid waste stream) in their counts, something not done in this report. There is no point in including yard wastes in this report as they are being recycled through composting already.

Phase II - Expansion

The schools looked at that have long-established programs show figures of on the order of 20% of their total solid waste is being recycled. In the Phase I program described above, the percentage of waste recycled was estimated to be on the order of this figure already. Therefore, the expansion in Phases II should leave Texas A&M in a very good position. Estimates for the second phase are, using the same assumptions as with the first:

<u>Material</u>	<u>Price</u>	<u>Pessimistic</u>			<u>Median</u>			<u>Optimistic</u>		
		<u>%</u>	<u>Wt</u>	<u>\$K</u>	<u>%</u>	<u>Wt</u>	<u>\$K</u>	<u>%</u>	<u>Wt</u>	<u>\$K</u>
Aluminum	\$720	20	60	43	50	150	108	50	150	108
Com. Pap.	\$103	30	412	42	60	825	85	70	962	99
Cardbrd	\$18	30	412	7	50	687	12	60	825	15
Newspap	\$6	30	60	.3	60	120	.7	60	120	.7
Mxd. Pap.	\$12	20	550	7	20	550	7	50	1375	17
<u>TOTALS</u>			<u>Tons</u>	<u>\$(000)</u>		<u>Tons</u>	<u>\$(000)</u>		<u>Tons</u>	<u>\$(000)</u>
			1494	\$99		2332	\$213		3432	\$240

REVENUES

Thus, under the Pessimistic Case, a total of 1,494 tons (20% of the annual total generated) of waste would be diverted from the landfill and sold for an estimated \$99,000. Under the Median Case, a total of 2,332 tons (31% of the annual total generated) of waste

would be diverted from the landfill and sold for an estimated \$213,000. Under the Optimistic Case, a total of 3,432 tons (45% of the annual total generated) of waste would be diverted from the landfill and sold for an estimated \$240,000.

Besides the recyclable materials sales, the landfill cost avoidance on them (at the current \$15 per ton) would amount to \$22,410 in the Pessimistic Case, \$34,980 in the Median Case, and \$51,480 in the Optimistic Case.

EXPENSES

For Phase II, it is assumed that the following people and equipment would be adequate. The same assumptions are made regarding the transportation and marketing costs. Of course, additional people are needed, along with more equipment.

In this second phase, hallway collection containers would be used by both students and staff. Folders like those in use at Rutgers or other inexpensive cardboard desktop containers could be used with the custodians either transporting the recyclables directly to the hall containers or using carts with two bags - one for trash and the other for recyclables.

It is estimated that the number of hallway containers would number one to every 50 waste containers now in use (12,230) and that each would cost \$100 which could be spread over a ten year life. Thus, a total of 250 hallway containers would be bought at an annual cost of \$2,500.

It is further estimated that the number of desktop containers would number one to every five (at this stage) waste containers now in use and that each would cost about \$1 and

be good for one year, at which time they would become recyclable material. Thus, a total of 2,500 desktop containers would be bought each year at a cost of \$2,500.

The custodial time to empty these additional containers is estimated at 15 minutes per day per hallway container and 30 seconds per day per desktop container. Again, it is assumed that the containers would be emptied five times per week, fifty weeks per year.

Thus, a total of about 15,625 hours would be spent on the hallway containers and about 5,200 hours on the desktop containers. The main containers used in Phase I would continue to be used, but since the program would not now be so isolated (other recycling activities going on in the same buildings), it is estimated that the time spent to empty them would decrease to about one half hour per container per week. This would cut total time on these 18 containers to about 2,250 hours each year. The average annual wage of \$5.00 is applied to these 23,075 hours to arrive at the cost.

<u>Asset</u>	<u>Annual Cost</u>
Director (full time)	\$30,000
Collectors/Sellers (5 students)	\$20,000
Trucks (2 ea. Step Vans and 1 Dump)	\$30,000
Desk Containers (2500)	\$2,500
Hall Collection Containers (250)	\$2,500
Custodial Time	\$115,000
Storage Facilities (temporary)	\$5,000
Total Costs	<u>\$205,000</u>

SUMMARY

Thus, under the three cases estimated:

<u>Case</u>	<u>Net Income (Loss)</u>
Pessimistic	(\$82,503)
Median	\$42,658
Optimistic	\$85,695

Note that the chance of making a profit appears to be reasonable. The figures used in the Pessimistic case are quite conservative (low), as are those used for the expenses (high). However, because the locations targeted in the pilot program (Phase I) are the "prime producers", the additional effort put into this expansion does not have a proportionately larger payback. That is, for an increase in costs to \$205,000, the expected revenue, in the Median Case, actually drops from $\overset{43,718}{\cancel{\$76,320}}$ to $\overset{42,658}{\cancel{\$42,980}}$.

One would have to try to factor in an "ecologic responsibility" benefit in order to institute this phase right now. Otherwise, it would also make sense to wait until landfill prices and/or recyclable material prices go up before implementing this second phase of the program. It is also quite likely that a contracted buyer would provide some of the containers and do some of the collection work. The figures would have to be adjusted to reflect any such agreement.

Phase III - Campus Wide

Under the third phase (complete campus-wide involvement), nearly all that is possible to collect of the waste stream for recycling would be collected. Using the same assumptions as above, the collection is estimated at:

<u>Material</u>	<u>Pessimistic</u>				<u>Median</u>				<u>Optimistic</u>			
	<u>Price</u>	<u>%</u>	<u>Wt</u>	<u>\$K</u>	<u>%</u>	<u>Wt</u>	<u>\$K</u>	<u>%</u>	<u>Wt</u>	<u>\$K</u>		
Aluminum	\$720	30	90	65	70	210	151	70	210	151		
Com. Pap.	\$103	40	550	57	70	962	99	80	1100	113		
Cardbrd	\$18	40	550	10	60	825	15	80	1100	20		
Newspap	\$6	40	80	.5	80	160	1	80	160	1		
Mxd. Pap.	\$12	30	825	10	50	1375	16	80	2200	26		
<u>TOTALS</u>			<u>Tons</u>	<u>\$(000)</u>		<u>Tons</u>	<u>\$(000)</u>		<u>Tons</u>	<u>\$(000)</u>		
			2095	\$143		3532	\$282		4770	\$311		

REVENUES

Thus, under the Pessimistic Case, a total of 2,095 tons (28% of the annual total generated) of waste would be diverted from the landfill and sold for an estimated \$143,000. Under the Median Case, a total of 3,532 tons (46% of the annual total generated) of waste would be diverted from the landfill and sold for an estimated \$282,000. Under the Optimistic Case, a total of 4,770 tons (63% of the annual total generated) of waste would

be diverted from the landfill and sold for an estimated \$311,000.

Besides the recyclable materials sales, the landfill cost avoidance on them (at the current \$15 per ton) would amount to \$31,425 in the Pessimistic Case, \$52,980 in the Median Case, and \$71,550 in the Optimistic Case.

EXPENSES

For Phase III, it is assumed that the following people and equipment would be adequate. The same assumptions are made regarding the transportation and marketing costs. Of course, additional people are needed, along with more equipment.

In this third phase, hallway collection containers would continue be used by both students and staff, as would the inexpensive cardboard desktop containers.

It is estimated that the number of hallway containers would now number one to every 30 waste containers now in use (12,230) and that each would cost \$100 which could be spread over a ten year life. Thus, a total of 400 hallway containers would be bought at an annual cost of \$4,000.

It is further estimated that the number of desktop containers would number one to every three waste containers now in use and that each would cost about \$1 and be good for one year, at which time they would become recyclable material. Thus, a total of 4,000 desktop containers would be bought each year at a cost of \$4,000.

The custodial time to empty these additional containers is still estimated at 15 minutes per day per hallway container and 30 seconds per day per desktop container. Again, it is assumed that the containers would be emptied five times per week, fifty weeks

per year.

Thus, a total of about 25,000 hours would be spent on the hallway containers and about 8,300 hours on the desktop containers. Time to empty the main containers would remain at about one half hour per container per week, for a total time on these 18 containers to about 2,250 hours each year. The average annual wage of \$5.00 is applied to these 35,550 hours to arrive at the cost.

<u>Asset</u>	<u>Annual Cost</u>
Director (full time)	\$30,000
Collectors/Sellers (5 students)	\$20,000
Trucks (2 ea. Step Vans and 2 Dumps)	\$40,000
Desk Containers (4000)	\$4,000
Hall Collection Containers (400)	\$4,000
Custodial Time	\$178,000
Storage Facilities (temporary)	\$5,000
Total Costs	<u>\$281,000</u>

SUMMARY

Thus, under the three cases estimated:

<u>Case</u>	<u>Net Income (Loss)</u>
Pessimistic	(\$107,845)
Median	\$54,635
Optimistic	\$102,210

Note that the chance of making a profit appears to be reasonable. The figures used in the Pessimistic case are quite conservative (low), as are those used for the expenses (high). However, once again, because the locations targeted in the pilot program (Phase I) are the "prime producers", the additional effort put into this expansion does not have a proportionately larger payback. That is, for an increase in costs to \$281,000, the expected revenue, in the Median Case, ^{rises} ~~actually drops~~ from ^{43,718} ~~\$76,320~~ to ^{54,635} ~~\$53,980~~ compared to Phase I. The difference over Phase II is slightly better (though still not yet justifiable) with revenue increasing from ^{42,658} ~~\$42,980~~ to ^{54,635} ~~\$53,980~~ in the Median Case.

One would again have to try to factor in an "ecologic responsibility" benefit in order to institute this phase right now. Otherwise, it would also make sense to wait until landfill prices and/or recyclable material prices go up before implementing this third phase of the program. Again, it is quite likely that a contracted buyer would provide some of the containers and do some of the collection work. The figures would have to be adjusted to reflect any such agreement.

Recommendations and Conclusions

While recycling is not an extremely simple process that is guaranteed to generate a lot of revenue, it does offer certain landfill cost avoidance. A large revenue should not be the only deciding criterion. Rather, recycling is a worthwhile pursuit for Texas A&M University right now from an ecological standpoint and in its role of shaping the attitudes of tomorrow's leaders. It is the duty of academic institutions to increase public awareness of problems, such as our looming landfill crisis, and to develop and implement solutions.

The estimates developed in this paper indicate that Texas A&M University could and should implement a pilot program right away, in an effort to organize the several activities currently in operation and establish new ones. A director should be appointed and funding provided, most logically under the solid waste division of the Physical Plant operations.

A widespread program does not yet appear to make economic sense as the incremental return on the added investment, even ignoring the time value of money, does not support it. However, it is important to begin planning for such a program as landfill costs and recyclable markets will continue to increase. At some point in the future, the economics of a wider program will make it attractive, or, like in New Jersey and North Carolina, legislation may mandate it!

Another option is use of an enforced program, wherein all university employees are required to collect and empty their own recyclable materials, similar to what they are doing at the University of Minnesota. Of course, this and any other steps taken to reduce the collection costs would directly increase the program revenues.

In summary, we must act now, while we have the luxury of time to plan and develop

an efficient, effective system, before landfill costs and problems here in Texas force us into a crisis reaction. Texas A&M University should commit to a program, beginning with a policy statement and establishment of a formal, organized recycling program.

Attachments

- A Rutgers Recycling Folder
- B Rutgers Recycling Guide for Custodians
- C Spreadsheet Estimates

RUTGERS UNIVERSITY EXPANDED RECYCLING PROGRAM

THIS IS A DESK COLLECTION FOLDER FOR
YOUR RECYCLABLE OFFICE PAPERS.
COLLECT ACCEPTABLE PAPERS INSIDE.
PERIODICALLY EMPTY INTO DESIGNATED
RECYCLING CONTAINERS NEARBY.

(FOR YOUR PROTECTION, CUSTODIANS HAVE BEEN
INSTRUCTED NOT TO REMOVE ANYTHING FROM YOUR DESK.)

IF YOU PREFER NOT TO USE THIS FOLDER,
YOUR REGULAR OFFICE TRASH BASKET CAN
BE LABELLED FOR RECYCLABLE PAPER. SEE
YOUR CUSTODIAL SUPERVISOR OR CALL THE
SERVICE DESK ON YOUR CAMPUS FOR ADDI-
TIONAL LABELS.

PLEASE RECYCLE THESE PAPER PRODUCTS:

White & colored paper, photo-copy paper, notebook paper,
computer printouts, manila folders, envelopes, booklets, bulletins
& flyers, carbonless forms, writing pads, forms in cellophane or
plastic wrappers, Post-It pads, junk mail, magazines, news-
papers,

NOT ACCEPTABLE

(Throw away with trash)

Pizza or cereal boxes and similar cardboard containers, photo-
copy papers wrappers, paper towels, kleenex, any brown
envelope, carbon paper, waxed paper, plastic coated paper
plates and cups, or any paper contaminated with food, oil, water
or solvents.

*FRONT COVER,
PAPER RECYCLING FOLDER*

QUESTIONS?

CALL: 932-5858

**R
E
C
Y
C
L
E**

THE STATE UNIVERSITY OF NEW JERSEY
RUTGERS

RECYCLING GUIDE

MATERIALS	WHAT IS ACCEPTABLE	HOW TO DISPOSE
ALUMINUM	Aluminum beverage cans NOT ACCEPTABLE Steel or food cans, aluminum foil or foil pans.	Empty the container. Place in recycling container in your area marked for aluminum and glass or place in any RED dumpster on campus.
GLASS CONTAINERS	Jars & bottles (food or beverage types). Clear, green, brown colors NOT ACCEPTABLE Light bulbs, fluorescent light tubes, laboratory glass, glass shelving, auto window glass, dishes, ceramics, window panes.	Same as above. No need to remove labels, rings, or caps.
PAPER	White & colored paper, photo-copy paper, notebook paper, computer printouts, manila folders, envelopes, booklets, bulletins & flyers, carbonless forms, writing pads, forms in cellophane or plastic wrappers, Post-It pads & sheets, junk mail, magazines, and newspapers. NOT ACCEPTABLE Pizza or cereal boxes and similar cardboard, photo-copy paper wrappers, paper towels, any brown envelope, carbon paper, waxed paper, or plastic coated paper plates and cups.	Place in recycling container in your area marked for paper. Place large quantities in any WHITE dumpster on campus.
CORRUGATED CARDBOARD	Boxes and shipping containers made of corrugated cardboard. Do NOT include plastic packing materials or waxed cartons. NOT ACCEPTABLE Cereal and pizza boxes, and similar cardboard containers.	Flatten boxes. Tie/tape into bundles no larger than 3'x3'x3'. Call x5858 for disposition.
OIL	Used motor oil from cars, motorcycles, lawn mowers, etc.	Drain into clean container. Take to service station that does vehicle oil changes and inspections. State law requires them to take uncontaminated oil.

ANY MATERIAL NOT SPECIFICALLY FOR RECYCLING SHOULD BE DISPOSED OF AS TRASH IN TRASH CONTAINER.

PLEASE
PUT ONLY APPROPRIATE MATERIALS
IN LABELED CONTAINERS.

REAR COVER
PAPER RECYCLING
FOLDER



IN NEW JERSEY, WE MUST ALL RECYCLE...IT'S THE LAW

RECYCLING GUIDE FOR CUSTODIANS

Why Recycle?

- Our landfills are full.
- Recycling is the right thing to do.
- Recycling saves power and materials.
- There is no easy way to get rid of waste.
- Recycling is the cheapest way to get rid of things you don't want.
- In New Jersey, we must all recycle. It's the law!

Tell everyone • RECYCLE

HERE'S WHAT WE RECYCLE:

- Aluminum beverage cans (aluminum does not stick to a magnet).
- Glass bottles and jars — clear, green, brown. (No light bulbs, fluorescent lights, lab glass)
- Papers from classrooms & offices — including computer print-out:
No pizza or cereal boxes, campus mail or any brown envelope, carbon paper, paper plates and cups, photocopy paper wrappers.
- Newspapers — including slick inserts.

Here's what you do

1. Check each recycling container. The label and its color tells what is supposed to be put there. Containers may hold:
 - aluminum cans & glass bottles, mixed
 - papers & newspapers, mixed
 - trash & garbage.
2. Take bags of trash or recyclables and empty into red, white or blue dumpsters (see below). Do not leave plastic bags, full or empty in the RED and WHITE dumpsters.

NOTE: Office occupants may choose to use existing trash containers for recyclable paper. Your supervisor can supply additional labels for this purpose.

RED dumpsters are for aluminum & glass containers only.

WHITE dumpsters are for paper and newspapers.

BLUE dumpsters are for trash/garbage.

Printed at an 11" x 14 PAPER

PHASE I - PESSIMISTIC CASE			NET REVENUE (LOSS): (\$16,160)		
Material	Average Price/Ton (\$)	Estimated Portion (Tons)	Estimated Percent (%)	Estimated Weight (Tons)	Estimated Revenue (\$)
Aluminum	\$720	300	10%	30.0	\$21,600
Computer Print	\$103	1,375	20%	275.0	\$28,325
Cardboard	\$18	1,375	20%	275.0	\$4,950
Newsprint	\$6	200	20%	40.0	\$240
Mixed Paper	\$12	2,750	10%	275.0	\$3,300
Total		6,000		895.0	\$58,415
Total Percent				11.8%	

PHASE I - MEDIAN CASE			NET REVENUE (LOSS): \$43,718		
Aluminum	\$720	300	20%	60.0	\$43,200
Computer Print	\$103	1,375	40%	550.0	\$56,650
Cardboard	\$18	1,375	30%	412.5	\$7,425
Newsprint	\$6	200	40%	80.0	\$480
Mixed Paper	\$12	2,750	10%	275.0	\$3,300
Total		6,000		1,377.5	\$111,055
Total Percent				18.1%	

PHASE I - OPTIMISTIC CASE			NET REVENUE (LOSS): \$86,950		
Aluminum	\$720	300	30%	90.0	\$64,800
Computer Print	\$103	1,375	50%	687.5	\$70,813
Cardboard	\$18	1,375	40%	550.0	\$9,900
Newsprint	\$6	200	50%	100.0	\$600
Mixed Paper	\$12	2,750	10%	275.0	\$3,300
Total		6,000		1,702.5	\$149,413
Total Percent				22.4%	

PHASE II - PESSIMISTIC CASE			NET REVENUE (LOSS): (\$82,503)		
Material	Average Price/Ton (\$)	Estimated Portion (Tons)	Estimated Percent (%)	Estimated Weight (Tons)	Estimated Revenue (\$)
Aluminum	\$720	300	20%	60.0	\$43,200
Computer Print	\$103	1,375	30%	412.5	\$42,488
Cardboard	\$18	1,375	30%	412.5	\$7,425
Newsprint	\$6	200	30%	60.0	\$360
Mixed Paper	\$12	2,750	20%	550.0	\$6,600
Total		6,000		1,495.0	\$100,073
Total Percent				19.7%	

PHASE II - MEDIAN CASE			NET REVENUE (LOSS): \$42,658		
Aluminum	\$720	300	50%	150.0	\$108,000
Computer Print	\$103	1,375	60%	825.0	\$84,975
Cardboard	\$18	1,375	50%	687.5	\$12,375
Newsprint	\$6	200	60%	120.0	\$720
Mixed Paper	\$12	2,750	20%	550.0	\$6,600
Total		6,000		2,332.5	\$212,670
Total Percent				30.7%	

PHASE II - OPTIMISTIC CASE			NET REVENUE (LOSS): \$85,695		
Aluminum	\$720	300	50%	150.0	\$108,000
Computer Print	\$103	1,375	70%	962.5	\$99,137
Cardboard	\$18	1,375	60%	825.0	\$14,850
Newsprint	\$6	200	60%	120.0	\$720
Mixed Paper	\$12	2,750	50%	1,375.0	\$16,500
Total		6,000		3,432.5	\$239,208
Total Percent				45.2%	

PHASE III - PESSIMISTIC CASE			NET REVENUE (LOSS): (\$107,845)		
Material	Average Price/Ton (\$)	Estimated Portion (Tons)	Estimated Percent (%)	Estimated Weight (Tons)	Estimated Revenue (\$)
Aluminum	\$720	300	30%	90.0	\$64,800
Computer Print	\$103	1,375	40%	550.0	\$56,650
Cardboard	\$18	1,375	40%	550.0	\$9,900
Newsprint	\$6	200	40%	80.0	\$480
Mixed Paper	\$12	2,750	30%	825.0	\$9,900
Total		6,000		2,095.0	\$141,730
Total Percent				27.6%	

PHASE III - MEDIAN CASE			NET REVENUE (LOSS): \$54,635		
Aluminum	\$720	300	70%	210.0	\$151,200
Computer Print	\$103	1,375	70%	962.5	\$99,137
Cardboard	\$18	1,375	60%	825.0	\$14,850
Newsprint	\$6	200	80%	160.0	\$960
Mixed Paper	\$12	2,750	50%	1,375.0	\$16,500
Total		6,000		3,532.5	\$282,648
Total Percent				46.5%	

PHASE III - OPTIMISTIC CASE			NET REVENUE (LOSS): \$102,210		
Aluminum	\$720	300	70%	210.0	\$151,200
Computer Print	\$103	1,375	80%	1,100.0	\$113,300
Cardboard	\$18	1,375	80%	1,100.0	\$19,800
Newsprint	\$6	200	80%	160.0	\$960
Mixed Paper	\$12	2,750	80%	2,200.0	\$26,400
Total		6,000		4,770.0	\$311,660
Total Percent				62.8%	

1618-582

Thesis
P74893 Potter
c.1 Solid waste recycling.



thesP74893

Solid waste recycling :



3 2768 000 89656 7

DUDLEY KNOX LIBRARY